Corporate Governance, Favoritism and Careers*

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Abstract

Careers are often shaped by favoritism, even though this undermines the performance of firms. When controlling shareholders weigh the efficiency costs of favoritism against its private benefits, the quality of corporate governance enhances meritocratic promotions and so encourages workers skill acquisition. The impact of labor market competition, however, is ambiguous: by raising wages upon promotion, it fosters the supply of skilled labor but lowers the demand for it. With endogenous skill acquisition, there are multiple equilibria, and social welfare increases with the share of meritocratic firms. This brings out a new efficiency rationale for enhancing the quality of corporate governance.

JEL: D21, D23, M50, M51.

Keywords: corporate governance, careers, favoritism, merit, job selection, skill development.

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1 Introduction

To a considerable extent the productive efficiency of firms hinges on appointing the right person to the right task. The power to hire, fire, promote and demote employees is thus clearly a key aspect of corporate control (Rohman et al., 2018). Whether or not this power is used to maximize profits depends on the alignment of managers' interests with those of investors. Where there is significant misalignment, appointments and promotions may be driven more by favoritism than by merit, resulting in inefficient organizational design and task assignment. In other words, the quality of corporate governance helps determine whether the careers of employees proceed according to merit or favoritism. This is the starting point of the analysis presented here. We show that the implications are far-reaching: corporate governance, by affecting personnel policies, impacts on the careers of employees, their matching with employers and, via their career incentives, their effort to acquire skills.

We posit a setting where firms are externally funded, so that career favoritism creates a conflict between controlling and non-controlling shareholders.[1] In the worse-governed firms, controlling shareholders assign greater value to the private benefits from favoritism than to the implicit efficiency cost of forgone productivity. When they apply for jobs, workers are aware that their skills will be better rewarded in the more meritocratic firms, as these not only promote for merit, but also pay higher salaries (to deter competitors from poaching their best employees upon promotion) and feature higher productivity (coordination tasks being entrusted to the most talented employees).

Higher corporate governance standards limit the private benefits of control and so increase the fraction of meritocratic firms, which attract high-skill employees. For a given distribution of skills across possible hires, there is a sorting equilibrium in which skilled

[1]The baseline version of the model assumes that firms are wholly equity-financed, but under fairly mild assumptions the results remain valid even where firms raise funds via risky debt.

workers apply to meritocratic firms, the unskilled to non-meritocratic ones. In this equilibrium, employment of higher-skill workers and aggregate productivity are increasing in the quality of corporate governance and decreasing in competition for workers: better governance increases firms' incentives to promote by merit, while less competition lowers the cost of retaining the employees promoted.

Corporate governance standards and competition between firms in the labor market also modify the skill composition of the workforce, by affecting skill acquisition choices. As these are based on expected earnings and promotions, better corporate governance stimulates the acquisition of the skills prized by meritocratic firms, and thereby raises the equilibrium fraction of skilled workers. Labor market competition, instead, has an ambiguous effect: on the one hand, the implied increase in earnings upon promotion encourages employees' skill acquisition and thus increases the supply of skilled labor; on the other hand, the higher cost of retaining workers after promotion reduces the fraction of firms that can afford to promote high-skill workers. In short, while better corporate governance unambiguously increases the equilibrium fraction of skilled workers, greater labor market competition may reduce it.

When workers choose whether to acquire skills, the model features multiple equilibria. There is an equilibrium in which both meritocratic and non-meritocratic firms are active and workers sort across them depending on skill level, as well as two extreme equilibria – one in which all active firms promote by merit and all workers acquire skills, and another in which none do. Equilibria with a larger fraction of meritocratic firms feature higher productivity, wages, profits and social welfare. This points to a new efficiency rationale for improving the quality of corporate governance, which works its effects via labor market outcomes and skill acquisition choices. However, the model also shows that, while sufficiently large improvements in corporate governance standards can shift the economy to a superior equilibrium, local improvements in these standards may not be efficient.

Our paper contributes to various strands of research. First, it relates to the normative

debate regarding the objective function of firms. The traditional view, dating back to Friedman (1962, 1970) and restated by Shleifer and Vishny (1997), is that firms should maximize shareholder value. However, more recently this view has been challenged, it being contended that firms should also consider the welfare of non-financial stakeholders (employees, customers and local communities). In particular, Magill et al. (2015) show that shareholder value maximization is inefficient when competitive firms generate negative externalities, and that the resulting inefficiencies can be corrected by the appropriate assignment of control rights to other stakeholders. Tirole (2001), while endorsing this objective, points out that it may ultimately tighten firms' financing constraint and generate other inefficiencies due to deadlocks in decision-making and lack of a clear mission for management. Our paper instead considers an instance in which shareholder value maximization entails positive externalities for non-financial stakeholders as well. In our setting, value maximization does not clash with concern for other stakeholders' welfare, as it results in higher wages and productivity than favoritism: reducing agency problems in corporate governance orients employment policies in a way that benefits non-financial stakeholders too.

Our work also relates to papers on corporate governance externalities by Acharya and Volpin (2010), Levit and Malenko (2016) and Dicks (2012), which show that firms' choices about corporate governance may affect their competitors' behavior in the market for managerial talent: given that poor corporate governance enables managers to extract high rents, firms that opt for it induce other firms to do the same, so as to retain their own managers. Our model also features a spillover effect of corporate governance, but instead of operating across firms via the market for managers, it runs from firms' governance to the demand for skilled and unskilled workers, and hence to the skill composition of the workforce, which eventually feeds back to productivity. The key difference is that unlike those papers, ours models general equilibrium interactions between corporate governance, labor market outcomes and firms' production decisions.

Finally, our analysis relates to research on workers' careers within organizations and on the efficiency costs of favoritism and discrimination at the workplace, already highlighted in the classic study by Becker (1957). Recently, Huang et al. (2021) have documented the pervasiveness of gender-based discrimination in promotions and its cost in terms of forgone profit for financial institutions in the U.S. mortgage loan market. Prendergast and Topel (1996) and Friebel and Raith (2004) analyze the impact of supervisors' discretion on promotions and on favoritism in organizations when supervisors promote less instead of more productive workers.[2] Empirically, there is solid evidence that good management practices, including those on promotions, foster productivity (Bloom and Van Reenen, 2007, 2010; Lemos and Scur, 2019). We show that deviations from such practices are not necessarily limited to family-owned firms, where dynastic succession is often associated with nepotism (Burkart et al., 2003; Burkart and Panunzi, 2006; Bennedsen et al., 2007). Instead, our model shows that even firms with widely-held ownership may deviate from merit-based promotion, as a smaller controlling stake creates greater incentives for favoritism. In these firms, corporate governance arrangements that limit the amount of private benefit extraction can also induce management to promote employees based on merit.

The paper is organized as follows. Section 2 lays out the model's structure. Section 3 analyzes the wage-setting process. Section 4 analyzes firms' financing and equilibrium promotion rules. Section 5 analyzes workers' choice to apply for jobs in meritocratic or in non-meritocratic firms. Section 6 describes workers' endogenous skill acquisition before entering the job market. Section 7 shows the conditions under which the results of the model map into a framework where firms are financed through debt. Section 8 concludes.

[2]Our paper also relates to the literature on the interplay between competition for talent and its allocation within firms dating back to Waldman (1984) and more recently DeVaro and Waldman (2012), Dato et al. (2021), Bar-Isaac and Levy (2022). In those works asymmetric information about workers' talent induces firms to misallocate high-skill workers (for instance, not promoting them as much as they should) so as to avoid poaching by their competitors. This literature, however, unlike the present paper, assigns no role to corporate governance in determining promotion rules and takes workers' characteristics to be exogenous.

2 The Model

We study a model of employees' careers in which favoritism in promotions can arise endogenously, depending on companies' ownership and corporate governance. The economy comprises a mass 1 of firms. To be productive, each firm requires N workers and a capital stock whose cost is standardized to 1. The controlling shareholder, termed for brevity "entrepreneur", funds the investment out of his wealth A and, if necessary, by issuing equity $1-A$ to a set of competing investors, entitling them to a fraction $1-\alpha$ of the firm's profits. All players are assumed to be risk-neutral and there is no discounting.

Firms can hire two types of workers: low-skill employees who produce revenue x irrespective of the task performed, or high-skill ones who generate x if assigned to a production task, and a larger revenue $(1+\Delta)x$ if trained to acquire managerial skills and promoted to a coordinating task. Workers' types are known at the hiring stage. The numbers of low- and high-skill workers in the representative firm are respectively denoted by N_L and N_H.

In each firm, the entrepreneur decides which workers to assign to production tasks and which to promote to coordinating tasks. Upon promotion, high-skill workers can produce the additional revenue Δx stemming from their managerial ability only if the entrepreneur does not require them to produce a private benefit B accruing to him, as this would keep them from managing subordinates properly: generating private benefits requires them to divert time and effort from productive tasks to inefficient activities that are valued by the entrepreneur, as in Friebel and Raith (2004), or to fraudulent practices beneficial to him, such as tax evasion. Hence, the opportunity cost of the private benefit B is the output Δx forgone by the diversion of these employees' skills. Instead, promoting low-skill workers does not entail this trade-off: if assigned to a managerial task, these employees cannot increase productivity in any case, while they are perfectly capable of producing the private benefit B. The latter may also capture some inclination to discriminate among subordinates in

promotions: for instance, a non-meritocratic entrepreneur who only appreciates the social skills of whites (or males) will promote them even if they are low-skill rather than non-whites (or females), who from his standpoint are unable to produce the private benefit.

Entrepreneurs' interest in the private benefit generated by promoted workers varies: with no loss of generality, it is assumed to be uniformly distributed across them, i.e., $B \sim U[0, \bar{B}]$. The probability that the entrepreneur will succeed in extracting such benefits is inversely correlated with the quality of corporate governance, denoted by $g \in [0, 1]$: the expected level of private benefits is $(1 - g)B$. This captures the idea that good corporate governance institutions, by protecting the interests of shareholders and enabling them to monitor the firm more closely, restrain the entrepreneur from diverting the skills of managers to inefficient or fraudulent activities that benefit him at the expense of non-controlling shareholders.

The labor force comprises M_H high-skill and M_L low-skill workers, so that $M = M_H + M_L$. The total labor force of the economy, M, exceeds aggregate labor demand ($M > N$), so that firms can hire all the workers needed to be productive. The $M - N$ unemployed workers earn the reservation wage, which for simplicity is standardized to zero.

The time line consists of four stages, as shown in Figure 1. At $t = 1$, workers apply for jobs and each firm hires N workers. At $t = 2$ firms raise external funds $1 - A$ by pledging a share of their profits to investors. At $t = 3$ each firm decides which employees to promote, and what salary to offer so as to retain them in the face of potential poaching by other employers. Finally, at $t = 4$, production occurs and profits and wages are paid out. In Section 6, we allow for an initial stage at $t = 0$ in which workers choose whether to invest costly effort in education, determining the skill composition of the labor force. The model is solved by backward induction to determine its subgame perfect equilibrium.

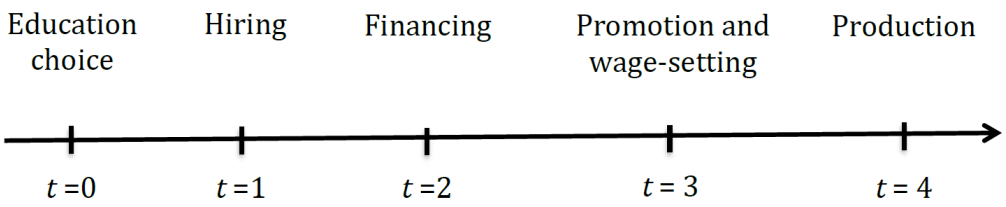

Figure 1: Time line of the model

3 Wage Setting and Promotions

After hiring, at $t = 3$ employers set wages and make promotion decisions in the shadow of labor market competition: after promotion, workers receive offers from other firms with probability $p \in (0, 1)$. When bidding, competing firms observe not only the types of existing employees but also whether they were promoted by their current employer. Recalling that high-skill employees' managerial talent develops upon promotion, promoted high-skill workers can be redeployed in competing firms as managers, so that they are more valuable from their standpoint than workers who were not promoted and low-skill promoted workers. While at the hiring stage firms can attract workers by just offering their reservation wage (i.e., they have all the bargaining power), at the poaching stage the probability p of receiving an outside offer confers some bargaining power to workers. The presence of poaching firms can be alternatively interpreted as capturing the option to switch to self-employment by workers after acquiring the necessary human capital on their initial job.

The incumbent employer matches poaching offers so as to retain workers, and is assumed to retain them in case of matching offers. Hence, equilibrium wages are

$$w = \begin{cases} p(1+\Delta)x & \text{for high-skill promoted workers,} \\ px & \text{otherwise.} \end{cases} \tag{1}$$

Given these wages, only low-skill workers will be asked to generate the private benefit B after promotion. To see why, notice that promoting a high-skill worker while requiring the generation of private benefits costs $p\Delta x$ more in wages than promoting a low-skill worker to do so: entrepreneurs who want the private benefits of control will find it efficient to promote low-skill workers to this end, while those who do not want such benefits will promote high-skill workers and get the productivity gain Δx. The former, that is, will indulge in favoritism, while the latter will adopt meritocratic promotion policies.

Each entrepreneur chooses between these two alternative policies, weighing the expected private benefit of control $(1-g)B$ from favoritism against the pro-rata monetary gain from the greater productivity brought about by meritocracy. An entrepreneur with a fraction α of the firm's equity is entitled to a commensurate share of the additional profit, i.e., the difference between the incremental revenue Δx and the incremental wage cost from promoting a high-skill worker, $p\Delta x$. Thus his pro-rata monetary gain is $\alpha(1-p)\Delta x$, and he will base promotions on merit if his fractional stake exceeds a threshold value:

$$\alpha \geq \frac{(1-g)B}{(1-p)\Delta x} \equiv \widehat{\alpha}, \tag{2}$$

and indulge in favoritism otherwise. Hence the entrepreneur's incentive for meritocracy is increasing in his stake in the firm, which determines the alignment of his personal objective to the maximization of share value. The threshold $\widehat{\alpha}$ is increasing in the ratio between the expected private benefit $(1-g)B$ and its opportunity cost Δx, as well as in the probability p that employees will receive offers from competing firms. Intuitively, greater $B/\Delta x$ strengthens the entrepreneur's incentive for favoritism, while greater p intensifies the competition for talent, and thus the cost of retaining high-skill workers.

It seems natural to assume that an entrepreneur who is sole owner ($\alpha = 1$) will not extract private benefits of control and may want to do so only when his stake is sufficiently low,

so that the cost of private benefit extraction is borne to some extent by outside financiers. Accordingly, in what follows we assume that when he is the sole owner, even the entrepreneur with maximal private benefit $\bar{B}$ under the worst possible corporate governance ($g = 0$) will promote employees according to merit:

$$\widehat{\alpha}(\bar{B}) = \frac{\bar{B}}{(1-p)\Delta x} \leq 1. \tag{3}$$

Under this assumption, if the entrepreneur could credibly commit not to extract private benefits, he would; and by the same token, good corporate governance ($g = 1$) is socially efficient. This assumption is important to the normative results of the paper, although it is not necessary for the positive results.

4 External Funding

If the entrepreneur's wealth is insufficient to wholly fund the firm's investment ($A < 1$), at $t = 2$ the firm must raise additional funds $1 - A$ by pledging a share $1 - \alpha$ of its profit π to outside financiers.[3] The rate of return that outside investors require on their funding $1 - A$ is zero, given the assumptions of no discounting, risk neutrality and perfect competition. Hence, the stake they require to fund the firm is given by their participation constraint:

$$(1 - \alpha)\pi = 1 - A, \tag{4}$$

which implicitly defines the fractional stake $\alpha \in [0, 1]$ in the firm's total cash flow that the entrepreneur retains after raising the external funds. The entrepreneur is assumed to retain control over the firm irrespective of his fractional stake.

[3] In the baseline version of the model, the firm is assumed to obtain external funding in the form of equity. Section 7 explores the robustness of our results to different capital structures.

The firm's profit rate depends on its promotion rule:

$$\pi = \begin{cases} \pi_H = (N + \Delta)(1 - p)x & \text{with meritocratic promotions,} \\ \pi_L = N(1 - p)x & \text{otherwise.} \end{cases} \tag{5}$$

We assume that $\pi_L \geq 1$, i.e. even firms that promote low-skill workers are viable, as their profits cover their cost of capital.

The entrepreneur decides on promotions by comparing his payoff per dollar invested $\alpha\pi_H$ under merit-based promotions with that under favoritism, $\alpha\pi_L + (1 - g)B$, considering that in both cases his stake in the firm is determined by the investors' participation constraint (4). This defines the optimal promotion policy:

Proposition 1 (Optimal Promotion Rule)**.** *The entrepreneur promotes high-skill workers if $B \leq B^*$ and low-skill workers if $B > B^*$, where*

$$B^* \equiv \frac{\Delta(1 - p)x(\pi_H + A - 1)}{(1 - g)\pi_H} = \frac{1}{1 - g}\left[\Delta(1 - p)x + \frac{\Delta}{N + \Delta}(A - 1)\right] > 0. \tag{6}$$

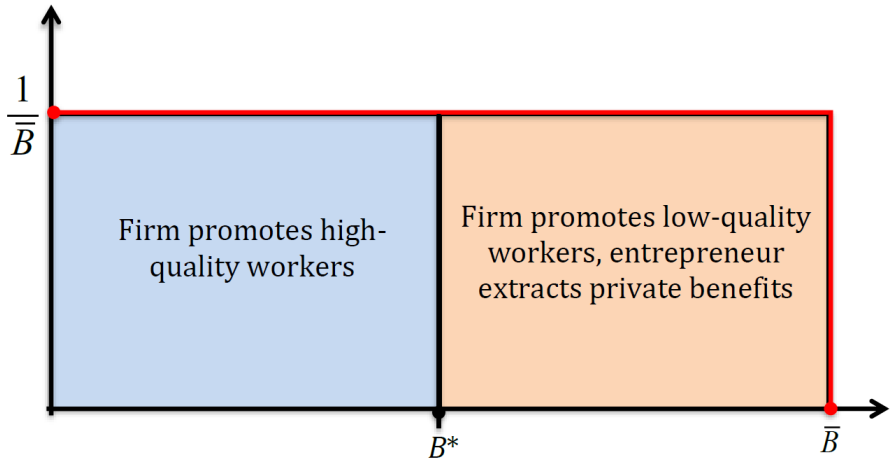

Figure 2: Private Benefits and Promotion Rules

In Figure 2, the fraction of meritocratic firms $q \equiv B^*/\bar{B}$ corresponds to the area to the left of the cutoff B^* in the cross-sectional distribution of private benefits, so that:

Corollary 1 (Determinants of Meritocratic Promotions)**.** *The fraction of meritocratic firms (q) is increasing in the quality of corporate governance (g), in the incremental productivity of promoted high-skill workers (Δx) and in the internal equity share (A), and is decreasing in labor market competition (p) and in the maximum potential private benefit ($\bar{B}$).*

Intuitively, better corporate governance limits the potential private benefits from favoritism, while more intense labor market competition increases the wages that must be paid in order to retain high-skill workers after promoting them, reducing the incentive to promote them accordingly. Hence, the model predicts that countries that score better on managerial practices regarding promotions (such as those by Bloom and Van Reenen (2007)) should also feature higher corporate governance standards and lower private benefits of control (as measured for instance by Dyck and Zingales (2004) and Desai et al. (2007)), as well as greater bargaining power of firms in the labor market (see Langella and Manning (2021)). The corollary also predicts that in a cross-section of firms favoritism and/or discrimination in employee promotions should be more common when the owner has a smaller inside equity stake and the firm is less closely monitored by outside investors, thus featuring lesser alignment of the entrepreneur's incentives with the maximization of shareholders' value.

5 Labor Market Allocation

At $t = 1$, workers allocate themselves across firms: they choose which jobs to apply for, and firms hire randomly from the pool of applicants.[4] When they apply, workers are aware

[4]The assumption that firms hire randomly from their applicant pool may appear surprising, as promotions in meritocratic (respectively, non-meritocratic) firms require at least one of their hires to be a high-skill (respectively, low-skill) worker. However, random hiring guarantees this requirement to be almost surely

of their own quality and of firms' future promotion policies and wages, distinguishing firms with merit-based promotion policies from those that indulge in favoritism. Since within each group all firms offer the same wages and promotion policies, workers simply choose whether to apply to one group or the other.

We denote by $m_i = M_i/M$ the fraction of workers of type i seeking jobs, and by $a_M = A_M/M$ the fraction of applicants for jobs in meritocratic firms, A_M being their absolute number. Workers choose whether to apply to a given firm on the basis of their belief about the number of applicants competing for jobs there: the larger the expected fraction $\widehat{a}_M$ of applicants to meritocratic firms, the lower the chance of being hired by these firms, hence the higher their probability of unemployment, which is assumed to imply a zero wage.[5]

High-skill workers will apply for jobs in meritocratic firms if they expect to earn more there than in non-meritocratic ones, i.e.:

$$\underbrace{\frac{q}{\widehat{a}_M}}_{\Pr(\text{hire}|M)} \left[\underbrace{\frac{1}{N_H}(1+\Delta)px}_{\mathbb{E}(w|\text{promotion})} + \underbrace{\left(1 - \frac{1}{N_H}\right)px}_{\mathbb{E}(w|\text{no prom.})} \right] > \frac{1-q}{1-\widehat{a}_M} px, \tag{7}$$

The left-hand side of inequality (7) is a high-skill worker's expected payoff from applying for jobs in meritocratic firms, i.e. the probability of being chosen from the relevant applicant pool multiplied by the expected wage paid by these firms, which in turn comprises the wage given promotion and that given no promotion, weighted by their respective probabilities. Symmetrically, the right-hand side of inequality (7) is a high-skill worker's expected payoff from applying for a job in a non-meritocratic firm, where the expected wage upon being hired is simply px, as in this case a high-skill worker cannot expect to be promoted. Clearly, the left-hand side is increasing in the fraction q of meritocratic firms and decreasing in the

met if the number of hires, N, is sufficiently large. For instance, the probability that a meritocratic firm hires at least one high-skill worker is $1 - (1 - N_H/N)^N$, which tends to 1 for $N \to \infty$.

[5] Allowing for a loss from unemployment would not change the results qualitatively.

fraction a_M of workers applying to these firms, while the opposite holds for the right-hand side: high-skill workers' incentive to apply for jobs in meritocratic firms is increasing in the fraction of such firms and decreasing in the fraction of workers competing for jobs there.

The problem faced by low-skill workers is simpler, since they earn the same expected wage px whether promoted or not. They will apply for jobs in non-meritocratic firms rather than meritocratic ones if

$$\frac{1-q}{1-\widehat{a}_M}px > \frac{q}{\widehat{a}_M}px, \tag{8}$$

where the left- and the right-hand side expressions are their expected wages if they apply for jobs in non-meritocratic and meritocratic firms, respectively. From condition (8), the incentive of low-skill workers that apply to non-meritocratic firms is increasing in the fraction $1-q$ of such firms and decreasing in the fraction of applicants competing for these jobs.

If both conditions (7) and (8) hold simultaneously, then only high-skill workers apply to meritocratic firms and only low-skill ones to non-meritocratic. The following proposition specifies the conditions under which this sorting equilibrium will obtain:

Proposition 2 (Labor Market Sorting)**.** *Only high-skill and low-skill workers apply to meritocratic and non-meritocratic firms respectively if* $\theta m_H < q < m_H$ *where* $\theta \equiv \frac{N}{(1-m_H)\Delta+N} \leq 1$*, so that in equilibrium the fractions of applicants for jobs in the two types of firms are equal to the fractions of high- and low-skill workers in the labor force (*$a^*_M = m_H$ *and* $1-a^*_M = m_L$*).*

Proposition 2 indicates that for a sorting equilibrium to exist, the fraction q of meritocratic firms must lie in an intermediate range: intuitively, it must be large enough to induce high-skill workers to apply only to such firms (satisfying condition (7)), but small enough to encourage low-skill workers to apply to non-meritocratic firms (fulfilling condition (8)). This is a subgame perfect equilibrium if all workers hold rational beliefs $\widehat{a}_M = m_H$, i.e., if high-skill workers can be expected to apply to meritocratic firms and low-skill workers to non-meritocratic firms.

In such a sorting equilibrium, meritocratic firms collectively hire qN high-skill workers and non-meritocratic firms $(1-q)N$ low-skill workers. Hence a larger fraction q of meritocratic firms translates into greater total employment of skilled workers and higher aggregate productivity. Recalling that by Corollary 1, q is increasing in the quality of corporate governance and decreasing in labor market competition at $t = 2$, the sorting equilibrium can be characterized as follows:

Corollary 2 (Characterizing the Sorting Equilibrium)**.** *In a sorting equilibrium, employment of high-skill workers and aggregate productivity are increasing in the quality of corporate governance (g) and decreasing in the degree of labor market competition (p).*

If the fraction q of meritocratic firms lies outside the interval $(\theta m_H, m_H)$, the sorting equilibrium cannot obtain. The question then arises whether any other subgame perfect equilibrium exists for such values of q. Consider first the case in which $q \leq \theta m_H$: here, the fraction of meritocratic firms is so small that high-skill workers have no special incentive to apply to them, condition (7) not being fulfilled, while low-skill workers do have the incentive to apply to non-meritocratic firms, as condition (8) is satisfied. In this situation, the only rational belief is that nobody will apply for jobs in meritocratic firms ($\widehat{a}_M = 0$), so they will be inactive. Hence, workers will rationally expect meritocratic firms to have zero mass: the equilibrium will feature $\widehat{q} = 0$, where $\widehat{q}$ denotes the fraction of *active* meritocratic firms. Conversely, if $q \geq m_H$, the fraction of meritocratic firms is so large that not only high-skill workers will apply for jobs in these firms (condition (7) being fulfilled), but low-skill workers as well (condition (8) being violated). In this scenario, all workers will seek work in meritocratic firms, so that $\widehat{a}_M = 1$, and only these firms will be active: the equilibrium will feature $\widehat{q} = 1$. Formally:

Proposition 3 (Corner Equilibria)**.** *If $q \leq \theta m_H$, the only subgame perfect equilibrium has $\widehat{q} = 0$, i.e. only non-meritocratic firms are active. Conversely, if $q \geq m_H$, the only subgame perfect equilibrium has $\widehat{q} = 1$, i.e. only meritocratic firms are active.*

It is important to notice that the subgame perfect equilibrium of the model is unique: depending on parameter values, there is either the sorting equilibrium where meritocratic firms are a fraction $\widehat{q} = q \in (\theta m_H, m_H)$ of active firms, as described in Proposition 2, or one of the two extreme equilibria described in Proposition 3, where all active firms are either non-meritocratic ($\widehat{q} = 0$) or meritocratic ($\widehat{q} = 1$).

This implies that a legal reform that improves corporate governance standards g, and so increases q (from Corollary 2), can have different effects depending on its magnitude: if initially the economy is in the sorting equilibrium, a small improvement in corporate governance increases q and thus the fraction of meritocratic firms; but a reform so drastic that it pushes q above the threshold m_H will alter the equilibrium, so that all active firms will start promoting by merit, i.e. $\widehat{q} = 1$. If instead the economy starts from this latter situation, small reductions in corporate governance standards (not pushing q below m_H) will leave the equilibrium unaffected. Symmetric considerations apply to reforms that, starting from the sorting equilibrium, worsen corporate governance: a severe enough deterioration in corporate governance can alter the equilibrium so that all active firms become non-meritocratic, i.e. $\widehat{q} = 0$; however, once the economy is in that extreme situation, marginal improvements in the quality of corporate governance (not pushing q above θm_H) will leave the equilibrium unaffected. In other words, when one of the two extreme equilibria obtains, modest reforms will be ineffective, since they will not trigger corresponding changes in labor market behavior. This suggests that complete disregard for merit may be a persistent feature, resistant to small-scale reforms, and that extreme meritocracy is an equally resilient outcome.

6 Endogenous Skill Acquisition

So far, the analysis has been predicated on an exogenous distribution of workers' abilities, treating the fraction m_i of workers of each quality $i = \{H, L\}$ as a parameter. However, workers' skill distribution can be endogenized at the first stage of the time line by positing that before entering the labor market workers can acquire valuable skills by exerting effort $e = \{0, 1\}$ at a cost $\psi \cdot e$, for $\psi > 0$: only workers who do so become high-quality. Effort is efficient, its benefit exceeding its cost: $qp\Delta x/N_H \geq \psi$.

Workers' choice of effort determines the fraction of high-skill workers m_H and is forward-looking, i.e. based on expected career prospects and therefore on workers' belief $\widehat{a}_M$ about the fraction of applicants to meritocratic firms. However, this fraction in turn depends on the fraction of high-skill job applicants, m_H: indeed, as noted above, in a sorting equilibrium the two coincide, i.e., $a_M^* = m_H$. Hence, in equilibrium workers must hold beliefs about a_M that induce them to exert the corresponding level of effort. In this section, we show that the model features multiple equilibria. Intuitively, this is because beliefs create a feedback loop between the availability of meritocratic careers and workers' initial skill acquisition effort: the larger the fraction of firms expected to promote according to merit, the greater the demand for skilled labor, hence the greater the incentive to acquire skills; in turn, the greater the fraction of skilled workers, the better the chance of attracting applicants suited to meritocratic firms, and hence the larger the fraction of such firms.

Specifically, the economy has three possible equilibria: (i) an intermediate equilibrium where the fraction of meritocratic firms' job applicants $\widehat{a}_M$ is such that $q \in (\theta\widehat{a}_M, \widehat{a}_M)$ so that, once on the labor market, educated and non-educated workers respectively apply to meritocratic and non-meritocratic firms; (ii) an equilibrium where no worker acquires skills and applies for a job in meritocratic firms ($\widehat{a}_M = 0$), so that these firms are inactive; and (iii) an equilibrium where all workers acquire skills and apply to meritocratic firms ($\widehat{a}_M = 1$), so

that only these firms are active.

We start by characterizing workers' skill acquisition and the resulting fraction of high-skill workers m_H^* in the intermediate equilibrium, where workers with differing skill attainments sort themselves between meritocratic and non-meritocratic firms:

Proposition 4 (Sorting Equilibrium with Endogenous Skill Acquisition)**.** *In the sorting equilibrium, the fraction m_H^* of skilled workers is uniquely defined by the indifference condition that balances the expected benefit of skill acquisition with its cost:*

$$\frac{N}{M}\left[\frac{q}{m_H^*}\frac{\Delta+N}{N}-\frac{1-q}{1-m_H^*}\right]px=\psi. \tag{9}$$

The equilibrium fraction m_H^* is increasing in the quality of corporate governance, g. The effect of an increase in labor market competition p is ambiguous: increasing in p for $p<p^*$ and decreasing for $p\geq p^*$, where $p^*\in(0,1/2)$.

The effect of corporate governance on the fraction m_H^* of educated workers as in Proposition 4 is quite intuitive: better corporate governance increases the fraction of meritocratic firms and thereby improves the expected career profile of skilled workers, thus increasing workers' incentive to acquire skills.

By contrast, the effect of labor market competition on the equilibrium fraction m_H^* of educated workers is ambiguous, because two effects are at play. On the one hand, sharper labor market competition increases workers' bargaining power, and thus the expected wage upon promotion, which encourages skill acquisition effort, expanding the supply of skilled labor. On the other hand, more competition for talent drives up the cost of retaining high-skill workers, which discourages firms from promoting workers efficiently and thus decreases the share of meritocratic firms q and so lowers the demand for skilled labor. The net effect depends on the balance between the positive effect on the supply of skilled labor and the negative effect on the demand for it. The first effect prevails if initially the labor market is

not too competitive ($p \leq p^*$), as this limits the impact of retention costs on the pursuit of meritocratic promotion policies. If instead the labor market is already highly competitive ($p > p^*$), then the second effect dominates, so that a heightening of competition will reduce the fraction m_H^* of skilled workers.

Figure 3 illustrates the effects of the quality of corporate governance g and labor market competition p on the equilibrium share of skilled workers m_H^*, plotted respectively on the vertical and the horizontal axis; lighter shading indicates a higher share. Each curve in the figure is an indifference locus corresponding to a different value of the fraction of skilled workers m_H^* as a function of g and p.[6]

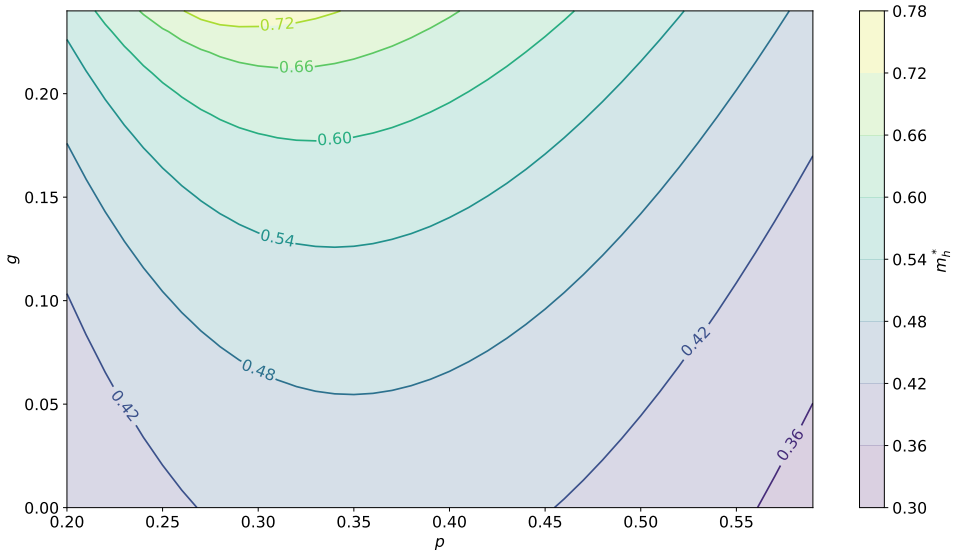

Figure 3: Corporate governance, labor market competition and fraction of skilled workers

For low values of p, the curves are downward sloping, so that upward and rightward movements are associated with higher values of m_H^*. Hence, in this parameter region the equilibrium fraction of skilled workers is increasing both in the quality of corporate gover-

[6]This figure is drawn for the following parameters: $N = 3$, $M = 37$, $\Delta = 2$, $x = 1$, $\psi = 0.3$, $A = 3$.

nance and in labor market competition: a larger fraction should be associated with better corporate governance standards or sharper competition for talented workers. For sufficiently high p, instead, the curves become upward sloping, so that upward and leftward movements are associated with higher m_H^*: in this region, better corporate governance still encourages workers to acquire skills, but labor market competition discourages meritocratic promotions. Hence, in this region a larger fraction of skilled workers should be associated with higher corporate governance standards and with less labor market competition between firms.

As noted earlier, the equilibrium as characterized to this point is not unique:

Proposition 5 (Corner Equilibria with Endogenous Skill Acquisition)**.** *The economy has two corner equilibria: (i) one in which nobody is expected to apply for jobs in meritocratic firms ($\widehat{a}_M = 0$) and no worker acquires skills at $t = 0$, so that $m_H^* = 0$; (ii) and one in which instead everyone is expected to apply ($\widehat{a}_M = 1$) and the share of workers acquiring skills at $t = 0$ is $m_H^* \in (0, 1]$.*

Intuitively, when workers hold extreme beliefs concerning the fraction of applicants for jobs in meritocratic firms, their choices too will be extreme. Specifically, if they imagine no one will apply, then they expect meritocratic firms to be inactive, being unable to attract the necessary workforce, and they will accordingly find it optimal not to acquire skills. The opposite holds if everyone is expected to apply for jobs in meritocratic firms.

Clearly, the equilibria with larger proportions of skilled workers are associated with greater workers' utility, as their expected lifetime income is higher, even taking into account the cost of acquiring skills. Moreover, the whole society is better off in equilibria that feature more meritocratic promotions, as condition (3) implies that the extraction of private benefits of control is inefficient. To see this, define social welfare as the average surplus produced by firms, inclusive of the private benefits that they generate. In the "meritocratic equilibrium"

(i.e., the corner equilibrium where all firms promote according to merit), social welfare is

$$SW_1 = (N + \Delta)x, \tag{10}$$

while in the intermediate equilibrium with labor market sorting it is

$$SW_2 = q(N + \Delta)x + (1 - q)\left[Nx + \frac{B^* + \bar{B}}{2}(1 - g)\right], \tag{11}$$

and in "non-meritocratic equilibrium", it is

$$SW_3 = Nx + \frac{B^* + \bar{B}}{2}(1 - g). \tag{12}$$

Since $SW_1 - SW_2 = (1-q)[\Delta x - \frac{B^*+\bar{B}}{2}]$ and $SW_2 - SW_3 = q[\Delta x - \frac{B^*+\bar{B}}{2}]$, by (3) $\Delta x - \frac{B^*+\bar{B}}{2}$, yielding $SW_1 > SW_2 > SW_3$, the three equilibria are Pareto-ranked. This provides a rationale for policies to foster the convergence of beliefs on equilibria where more workers invest in skill acquisition and more firms base their promotions on merit.

This does not imply, however, that an increase in the quality of corporate governance standards is always beneficial in terms of social welfare. To see this, consider the case in which the economy is in the "non-meritocratic equilibrium" and note that expression (12) for social welfare SW_3 in this equilibrium can be rewritten as follows, using expression (6) for B^*:

$$SW = Nx + \frac{1}{2}\Big[\Delta(1 - p)x + \frac{\Delta}{N + \Delta}(A - 1)\Big] + \frac{\bar{B}}{2}(1 - g), \tag{13}$$

which is decreasing in the quality of corporate governance, g. Intuitively, if the government were to increase g in this equilibrium, without triggering a switch of the economy to one of the other two equilibria, it would reduce the private benefits enjoyed by entrepreneurs without any countervailing increase in production and thus in workers' income, as firms will still promote low-skill workers but will manage to extract lower expected private benefits.

By the same token, an increase in the quality of corporate governance standards can increase welfare only if it is sufficiently large as to shift the economy to one of the two other equilibria. Hence the model predicts that society may resist reforms implying marginal improvements in corporate governance standards, while it may embrace much more drastic increases in these standards, which are capable of changing the operation of the labor market and of firms' promotion policies at large.

Let us now consider the impact of an increase in the quality of corporate governance standards when the economy is in the intermediate equilibrium. In this scenario, social welfare is defined by (11).

Proposition 6. *If the economy is in an intermediate equilibrium, an increase in the quality of corporate governance standards:*

- *Improves social welfare if* $\bar{B} \leq \sqrt{B^o(2\Delta x - B^o)}$*;*
- *Improves social welfare* $\forall g \geq \underline{g}$ *and reduces it* $\forall g < \underline{g} \in (0,1)$*, if* $\bar{B} > \sqrt{B^o(2\Delta x - B^o)}$

with $B^o \equiv B^*(1-g)$ *and* $\underline{g} \equiv 1 - \sqrt{\frac{B^o}{\bar{B}}(2\Delta x - B^o)}$.

This is an interesting result, as it shows that even when the economy is in an intermediate equilibrium, if the maximum private benefit entrepreneurs can extract is sufficiently large, then the average private benefit in the economy is large too, hence, the impact of an increase in the quality of corporate governance standards may be not obvious. Specifically, if the economy begins from a sufficiently low level of corporate governance quality, increasing it would reduce social welfare.

7 Allowing for Debt Financing

So far the assumption has been that all external funding is in the form of equity. In this section we extend the model to allow for debt financing, which will be seen to have quite different implications for promotion decisions (and therefore for the extraction of private benefits) depending on whether the firm's profits are deterministic or uncertain.

In the baseline model presented so far there is no risk: the firm is always able to repay outside investors. Insofar as it is risk-free, debt has no impact on promotion decisions, unlike equity. This is because, when debt is risk-free, creditors receive a fixed amount irrespective of profit, while external shareholders receive a certain fraction of the firm's profit, and thus bear that fraction of the opportunity cost of favoritism. Hence, unlike equity, safe debt does not encourage favoritism. To see this, suppose that the firm funds investment by issuing safe debt, pledging to repay a fixed amount D to outside investors. In this case the entrepreneur will promote high-skill rather than low-skill workers if

$$[(N + \Delta)(1 - p)x] - D > N(1 - p)x - D,$$

that is, he will adopt the following promotion rule:

$$\Delta(1 - p)x \geq B.$$

In short, when safe investment projects are debt-financed, the entrepreneur follows the same promotion rule as under full ownership, irrespective of the amount of external funds.

By contrast, when equity and debt are equally risky they have the same impact on promotion decisions; this occurs either if the firm fails to produce anything or if it succeeds in producing some positive amount, and shareholders have limited liability. In this case, both debt and equity distort promotions towards favoritism in the same way. To see this,

consider a simplified version of the model in which both high- and low-skill workers increase firms' productivity by the same amount Δx, so that the firm's profit is $\pi \equiv (N+\Delta)(1-p)x$, but this is realized only with probability p_H if high-skill workers are promoted and p_L if low-skill workers are promoted, with $p_H > p_L$. If the firm raises funds by issuing equity, the entrepreneur promotes according to merit if

$$\alpha \geq \frac{(1-g)B}{(p_H - p_L)\pi} \equiv \widehat{\alpha} \tag{14}$$

where $\widehat{\alpha} \leq 1$ requires $\bar{B} \leq (p_H - p_L)\pi$.

If instead it covers its funding requirement $1 - A$ by contracting debt that promises to repay D upon success and 0 upon failure, the entrepreneur promotes high-skill workers if

$$p_H(\pi - D) \geq [p_L\pi + (1-g)B] - p_L D. \tag{15}$$

Hence the firm promotes high-skill workers if the payoff pledged to debtholders is sufficiently low:

$$D \leq \widehat{D} \equiv \frac{[(p_H - p_L)\pi - (1-g)B]}{p_H - p_L}, \tag{16}$$

while if the firm is sufficiently indebted, promotions are not meritocratic.

Recalling that D is the total cash flow pledged to debtholders, the model with risky debt maps one-to-one onto the framework with equity. To see this, consider the maximum cash flow that can be pledged to outside financiers for promotions to be efficient. In an all-equity firm, this cash flow is defined by expression (14) taken with equality, while in a firm funded with risky debt it is given by expression (16) taken with equality. In both cases, the cash flow is given by the same expression, namely, $(1 - \widehat{\alpha})\pi$. Hence, in a debt-financed firm, the maximum indebtedness consistent with meritocratic promotions is $\widehat{D} = (1 - \widehat{\alpha})\pi$.

Summarizing the foregoing, while safe debt does not distort promotion towards fa-

voritism, risky debt distorts decisions in the same way as equity if the two claims feature the same payoff distribution for any given promotion rule. Hence, the model developed in the previous sections applies also to firms funded with risky debt rather than equity.[7]

8 Conclusions

Employees' careers may be shaped by favoritism and discrimination, however costly this may be to the firm's profitability (Becker, 1957, 1993; Huang et al., 2021). We show that firms tend to deviate from merit-based promotion when the objectives of their controlling shareholders are not well aligned with those of external financiers: in this case, they have an incentive to pursue their own non-monetary benefits rather than maximize profitability. However, corporate governance standards may constrain the possibility of engaging in such practices, and the model accordingly predicts that at the aggregate level the share of meritocratic companies should increase with the quality of corporate governance standards and, in a cross-section of firms, structured managerial practices should be correlated with the alignment of the interests of owner-managers with those of external shareholders, as measured for instance by inside equity.

By increasing the fraction of meritocratic firms, higher standards of corporate governance also affect the incentives of workers, encouraging the skilled to apply for jobs with better career prospects and to invest in their human capital before entering the labor market. Conversely, poorer standards increase the fraction of firms that promote unskilled workers, which depresses the incentive to acquire skills. Our model accordingly predicts that good corporate governance will ultimately improve the skill composition of the workforce, via

[7]In intermediate cases where debt is safe up to some threshold level and increasingly risky beyond it, external debt financing tends to distort promotion decisions towards favoritism less than equity financing, as can be shown by assuming that the firm produces a positive surplus also in the low state or, equivalently, has some safe assets whose value can be pledged to creditors.

career incentives and labor market equilibrium, and thereby raise aggregate productivity. Moreover, since in our setting the extraction of private benefits is inefficient, high corporate governance standards are an efficient form of precommitment to shun favoritism.

Labor market competition too plays a role in firms' promotion policies and workers' skill acquisition choices, but its effect is ambiguous. Sharper competition between firms for talent means higher wages upon promotion and thus increases workers' incentive to acquire skills, but it also increases talent retention costs for firms, thus reducing the proportion of meritocratic firms. As a result, the equilibrium fraction of skilled workers may shrink, especially if the economy starts from a situation of sharp labor market competition.

Finally, when skill acquisition is endogenous, multiple equilibria may arise, in which case the share of meritocratic firms correlates positively with that of skilled workers across equilibria. This is because beliefs engender a feedback loop between meritocratic careers and educational choices: the higher the chance of being hired by a firm that promotes by merit, the greater the incentive to acquire skills; in turn, the larger the fraction of educated workers, the better a meritocratic firm's chance of attracting applicants, and thus of being active. Social welfare also increases monotonically across equilibria featuring different shares of meritocratic firms.

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Appendix

Proof of Proposition 1

We prove this proposition by induction. The equilibrium stake that satisfies the investors' participation constraint (4) may either violate or satisfy the entrepreneurs' incentive constraint (2). Violation occurs if the stake that meets the participation constraint is $\alpha_L^* < \widehat{\alpha}$, which can be rewritten as a condition on B:

$$B > \frac{\Delta(1-p)x[(\pi_L - 1)I + A]}{(1-g)\pi_L I} \equiv B^{**} \tag{17}$$

Hence, an entrepreneur extracting private benefits of control $B > B^{**}$ inefficiently promotes low-skill workers.

Satisfaction occurs if the stake that meets the participation constraint is $\alpha_H^* > \widehat{\alpha}$, which yields another condition on B:

$$B \leq \frac{\Delta(1-p)x[(\pi_H - 1)I + A]}{(1-g)\pi_H I} \equiv B^{*}. \tag{18}$$

Hence, when extracting private benefits $B < B^*$, the entrepreneur promotes high-skill workers. Using (5), we can rewrite $B^* \equiv \frac{1}{1-g}\left[\Delta(1-p)x + \frac{\Delta}{N+\Delta}\left(\frac{A}{I} - 1\right)\right]$.

Comparing the two cutoffs B^* and B^{**}, one sees immediately that $B^* \geq B^{**}$, and the interval (B^{**}, B^*) is non-empty.

Let us now determine the entrepreneur's promotion strategy for any $B \in (B^{**}, B^*)$. Compare the payoffs $\alpha_H^* \pi_H I$ and $\alpha_L^* \pi_L I + (1-g)BI$. This implies that the entrepreneur promotes high-skill workers in this interval if

$$\Delta(1-p)x > (1-g)B$$

which is necessarily satisfied given the assumption that $\widehat{\alpha} < 1 \iff \Delta(1-p)x > \bar{B}$ which we assume to be true. Hence, the promotion rule is such that the entrepreneur promotes high-skill workers if she extracts private benefits of control $B \leq B^*$ and low-skill workers otherwise. ■

Proof of Proposition 3

First, consider the case in which $q \leq m_H$, i.e. workers expect a_M to be sufficiently large in relation to the fraction of meritocratic firms. Since workers hold homogeneous beliefs, no one will apply for jobs in meritocratic firms, so that the only reasonable belief is that $a_M = 0$. In this scenario, meritocratic firms will be unable to attract any worker and therefore will be inactive, so that in this equilibrium $q = 0$.

If instead $q \geq m_H$, i.e. workers expect a_M to be sufficiently small in relation to the fraction of meritocratic firms, then all of them will apply to these firms, so that $a_M = 1$ and $\theta = 1$. In this case only meritocratic firms will attract workers and will therefore be the only active firms, so that in this equilibrium $q = 1$. ■

Proof of Proposition 4

Denote the equilibrium fraction of skilled workers by m_H^*. Workers have an incentive to acquire skills if the marginal benefit from doing so exceeds the marginal cost, i.e.

$$\underbrace{\frac{NI}{M}\left[\frac{q}{m_H^*}\frac{\Delta+N}{N} - \frac{1-q}{1-m_H^*}\right]px}_{\equiv\bar{\psi}} \geq \psi. \tag{19}$$

Denote by $\bar{\psi}(m_H^*, N, \Delta, N, M, x, \bar{B}, p, g)$ the expected benefit from skill acquisition in the sorting equilibrium. If condition (19) is taken with equality, it defines a unique fraction of

workers m_H^* acquiring skills, such that $\psi = \bar{\psi}(\cdot)$, as $\bar{\psi}(\cdot)$ is monotonically decreasing in m_H^*.

To determine the impact of corporate governance quality (g) and labor market competition (p) on the equilibrium share of high-skill workers, we can fix m_H^* and characterize the loci along which m_H^* is constant in the $(g, p)-$space.

First, rewrite the indifference condition (9) as follows:

$$g = 1 - \frac{\Delta p x}{\bar{B}[M\psi(1-m_H^*) + NIpx]} \left[\frac{\Delta(1-m_H^*)+N}{m_H^*}\right] \left[\frac{(N+\Delta)(1-p)xI - I + A}{N+\Delta}\right], \quad (20)$$

Equating its derivative with respect to p to zero in order to identify an internal extremum yields the following quadratic equation

$$p^2 NIx + 2p(1-m_H^*)M\psi - \rho = 0 \quad (21)$$

with $\rho \equiv \frac{M\psi(1-m_H^*)[(N+\Delta)Ix-(I-A)]}{(N+\Delta)Ix}$. Since $p \in [0,1]$, this equation has only one positive root:

$$p^* = \frac{\sqrt{[M\psi(1-m_H^*)]^2 + NIx\rho} - M\psi(1-m_H^*)}{NIx}. \quad (22)$$

From (22), we see that $p^* \geq 0 \iff I - A \leq (N+\Delta)Ix$. Since by assumption $\pi_L \geq 1$, namely $N(1-p)xI \geq I$, *a fortiori* the above condition is met with inequality, so that $p^* > 0$. Moreover, $p^* < \frac{1}{2}$ if $-4M\psi(1-m_H^*)(I-A) < 0$ which is trivially satisfied.

Taking the second derivative of (20) yields:

$$\frac{\partial^2 g}{\partial p^2} = 1 + \frac{(N+\Delta)(1-p)xI - I + A}{(N+\Delta)\bar{B}[M\psi(1-m_H^*) + NIpx]} > 0.$$

Hence, the root p^* in (22) is a minimum, since the second derivative of (20) with respect to

p is strictly positive: condition (20) defines convex loci in (g, p) space, so that

$$\frac{\partial g}{\partial p} \geq 0 \text{ iff } p \geq p^*,$$

where $p^* > 0 \iff (N + \Delta)Ix \geq I - A$. ■

Proof of Proposition 5

Let us start with the case of $\widehat{a}_M = 0$. In this scenario, no meritocratic firm is expected to be active, i.e. $\widehat{q} = 0$. Hence, using the right-hand side of (7) and the left-hand side of (8), workers would exert effort if

$$(1 - q)px - \psi \geq (1 - q)px,$$

which is violated, since $\psi > 0$. Thus, in equilibrium, the fraction of high-skill workers is $m_H^* = 0$.

Consider now the case in which $\widehat{a}_M = 1$. In this scenario, a worker compares the payoff on the left-hand side of (7) with that on the right-hand side of (8), and thus exerts effort if

$$q\left[\frac{1}{N_H}(1 + \Delta) + \left(1 - \frac{1}{N_H}\right)\right]px - \psi \geq qpx \iff \psi \leq qp\Delta x/N_H.$$

If this condition is not satisfied, there is no equilibrium where workers do not exert effort: this would imply $N_H = 0$, which, in turn, violates the condition for any finite ψ. Conversely, there is an equilibrium in which the number of workers per firm who exert effort is

$$N_H^* = \min\left\{\frac{qp\Delta x}{\psi}, N\right\}.$$

To see why, consider that if $qp\Delta x/\psi < N$, then workers are indifferent between exerting effort and not; if $N_H^* = qp\Delta x/\psi$, then none of them choose to do so ???This sentence is missing something; if instead $qp\Delta x/\psi \geq N$, then all workers have the incentive to exert effort. In the first case, the fraction of skilled workers in the workforce is $m_H^* \in (0,1)$; in the second, it is $m_H^* = 1$. ■

Proof of Proposition 5

To prove this proposition let us firs of all define $B^o \equiv B^*(1-g)$, so that, since we aim at analyzing how a variation of g affects social welfare, B^o is a constant term. BY means of this definition, the first derivative of the social welfare function described by (11) with respect to g is

$$\frac{\partial SW_2}{\partial g} = \frac{B^*}{\bar{B}(1-g)}\left(\Delta x - \frac{B^o}{2}\right) - \frac{\bar{B}}{2}. \tag{23}$$

From (23) it is immediate that

$$\frac{\partial SW_2}{\partial g} \geq 0 \iff B^o\big(2\Delta x - B^o\big) \geq \big[\bar{B}(1-g)\big]^2$$

whence we derive the condition

$$g \geq \underline{g} = 1 - \sqrt{\frac{B^o}{\bar{B}^2}(2\Delta x - B^o)}. \tag{24}$$

Since $2\Delta x > B^o$, $\underline{g} < 1$. We now need to verify if and when it is larger than zero: $\underline{g} > 0 \iff \bar{B} > \sqrt{B^o(2\Delta x - B^o)}$.

Finally, let us consider the second derivative of the social welfare function with respect to g :

$$\frac{\partial^2 SW_2}{\partial^2 g^2} = 2B^*(2\Delta x - B^o) > 0$$

hence, social welfare is convex in g and, if $\bar{B}$ is sufficiently large, $\underline{g}$ is a global minimum of the function. ■